

ABC of preterm birth

Moving the preterm infant

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Many different health service models for providing neonatal intensive care have been established over the past 30 years, and much of the developed world is moving towards a centralised model of care. At least initially, preterm infants often require specialised care in an intensive care setting. As a result, newborn infants and pregnant mothers may have to move between hospitals for appropriate care because of prematurity or the threat of preterm delivery. Sometimes this move means that the infant and family have to travel hundreds of miles.

This article focuses on the postnatal transfer of preterm infants between hospitals. Antenatal transfer of pregnant women is not considered here, although in utero transfer has better clinical outcomes for mother and infant than transfer after birth. Many of the issues discussed are applicable to transfers within hospitals.

Interhospital transport services

In utero transfer is not always possible—for example, if labour is too advanced. Of the several models for transporting newborn infants, the most sophisticated are regional transport services that carry out all neonatal moves in a defined area using dedicated staff and equipment. These teams are responsible for neonatal transport only and are often “independent,” not being affiliated to a particular maternity or neonatal unit. A medical director usually runs such regional services, and the staff carrying out the transports may be medical or nursing staff with other professionals sometimes contributing. Referring hospitals and receiving hospitals do not have to provide staff or equipment, and each transport is undertaken by dedicated staff who have training and experience in transporting sick neonates.

When no regional transport service is available, medical and nursing staff from either referring or receiving units undertake the transport on an ad hoc basis. The staff will have variable experience in neonatal transport and the equipment used, and the vehicle may not be dedicated for neonatal use. Running these ad hoc teams often puts resources under strain because there will be fewer staff on site in the unit that carries out the transport. With less experienced staff, the risk of adverse events on such transports can be greater than with dedicated teams. In some parts of the world even ad hoc transport services are not available and transports with no clinical escort or untrained escorts use unsuitable equipment and vehicles.

Safe transport of the preterm infant

Anticipating the need for transfer early, appropriate preparation for transfer, and ongoing high quality care during transfer, are the cornerstones of good neonatal transport. To achieve this staff need to be trained appropriately, all equipment and vehicles must be fit for the purpose, and lines of communication must be well established.

Anticipation

When in utero transfer is not possible, there may still be an opportunity to seek advice, gather staff with the right skills, and prepare appropriate equipment. Direct communication between senior staff in the two centres involved is important.

This is the fifth in a series of 12 articles



Neonatal transport system—mobile intensive care unit for safe and comfortable transport of infants

Reasons for transferring preterm infants between hospitals

- No appropriate local neonatal facilities
- No cots available locally (neonatal intensive care unit or special care baby unit “full”)
- Insufficient appropriate nursing or medical staff available locally—for example, paediatric surgeons, cardiologists
- Unexpected delivery far from home
- Transfers back to local facility



An ambulance dedicated to, and equipped for, neonatal transport

The ethos of neonatal transport medicine is to keep the infant stable and, preferably, improve the clinical status of the infant

Stabilisation

Preparing for transport begins as soon as the decision to move an infant is made. Specific treatments such as antibiotic treatment, surfactant replacement, volume support or inotrope support, analgesia, sedation, paralysis, anticonvulsant treatment, and nitric oxide should be considered. Any remedial action should be taken before moving the baby and not during the transport. Although the infant should be in as good a clinical condition as possible before setting off, the decision to stabilise the infant further or institute specific treatments must be weighed against a delay in transfer. These difficult decisions should be made in collaboration with experienced staff. The choices made will depend on many factors, including the clinical condition and progress of the infant, experience of staff on site, and equipment and treatments available.

Infant care during the journey

With good preparation and stabilisation before setting off, minimal active intervention should be needed during the transfer. However, infants can deteriorate spontaneously (for example, pneumothorax), or equipment (for example, endotracheal tubes and intravenous lines) can be dislodged. Equipment to deal with such eventualities must be carried.

The infant's temperature should be maintained during any journey. When possible, the environmental temperature of the vehicle should be raised.

Communication and documentation

Good verbal and written communication between health professionals throughout transport episodes is vital. Using clinical guidelines, operational policies, and checklists is helpful. Parents also need to know plans for their baby's care, and the transport team should meet the parents when possible. In some settings informed consent is needed for transport and care. If parents are not travelling in the ambulance with their infant, they may need to know how to get to the destination hospital and what facilities will be available for them when they arrive. Helpful written information (for example, leaflets about the destination neonatal unit and maps) can be stored electronically and downloaded as needed.

Choice of vehicle

Different types of vehicles can be used to transport neonates. The mode of transport that is most appropriate will depend on resource availability, geography, clinical pathology, urgency of the situation, and the experience of the staff. More organisation is needed for an air transfer than for road transfers. Air transfer also requires specialist training and skills from staff, and the important physiological effects of flying must be taken into account. These effects include hypoxia, barometric pressure drop, thermal change, dehydration, gravitational forces, noise, vibration, and fatigue.

Equipment

Systems are based around an incubator fixed to a transport trolley with integrated ventilator, monitor, intravenous pump, and medical gas supply. Unfortunately, an infant cannot be secured in the transport incubator itself, and so is susceptible to substantial movement and potential trauma if there is sudden movement. Comfort factors (such as warmth, noise reduction, padding, and chemical sedation) can be adjusted.

The equipment should be designed to function while in motion. Although adequate portable power sources should be available, all equipment should be run from the transport vehicle's power supply if possible. Medical gases sourced from the transport vehicle should be used whenever possible.

Clinical stabilisation before transfer

Airway

- Is the airway patent?
- Is the airway secure?

Breathing

- Is the infant making sufficient spontaneous respiratory effort?
- If not, is artificial ventilation adequate?

Circulation

- Are the baby's essential organs perfusing adequately?

Metabolic

- Is the baby's blood glucose adequate?
- Is the baby's acid-base balance acceptable?

Temperature control

- Is the baby's temperature normal?
- Is the baby in a thermoneutral environment?

Comfort

- Is the baby being exposed to any noxious stimuli?
- Does the baby need chemical sedation?

Minimising heat loss from the infant during transport

- Raise the environmental temperature of the vehicle if possible
- Ensure doors of vehicle are closed
- Ensure doors of transport incubator are closed
- Use a heated gel mattress (also helps absorb vibration and improve general comfort for the infant)



Scottish ambulance service helicopter—air transfer may be used to move infants depending on factors such as the geography of the journey, urgency of the situation, and the experience of the available staff

Transport equipment*

- Transport incubator mounted on appropriate trolley
- Monitors for heart rate, respiratory rate, temperature, blood pressure (invasive and non-invasive), inspired oxygen concentration, oxygen saturation, and end tidal carbon dioxide
- Assisted ventilation equipment
- Suction apparatus
- Equipment for intubation, intravascular infusion (central or peripheral, venous or arterial), chest tube placement
- Drugs
- Portable blood gas analyser
- Portable blood glucose analyser
- Medical gases (oxygen, air, and nitric oxide)

*This list is not all-inclusive, and equipment taken on neonatal transport must be appropriate for the clinical situation and the likely journey

Estimates for the quantity of all medical gases needed should allow for delays. Gas consumption can be estimated as flow delivered (l/min) \times fraction of inspired oxygen \times journey time (minutes) \times 2.

Many types of equipment bag exist and their contents vary, depending on the type of move. Bearing in mind that too much can cause confusion in an emergency, equipment should be kept to the minimum required for essential procedures.

Staff safety

Transport systems should comply with regulations on the safe loading and fixation of transport incubators in vehicles. Staff may sustain serious injury if loose equipment is dislodged during a journey, or while loading the transport systems. Historically, transport systems have been extremely heavy, sometimes over 200 kg, although lighter systems have now been developed. In the United Kingdom the health and safety regulation limit is 140 kg. The transport system must be fixed securely in the vehicle using a mechanism that has been appropriately "crash tested." All employers should have adequate insurance that covers staff and equipment.

Personnel and training

Transporting sick preterm infants requires specific skills and a high level of clinical competence. All staff involved—medical, nursing, paramedical, and others such as medical physicists—should have appropriate training in neonatal transport medicine, be familiar with local organisational procedures, and know how to use the equipment. No agreed standards on training in neonatal transport medicine exist in the United Kingdom. However, formal training programmes are becoming available.

Risk management

Clinical risk management aims to identify shortfalls in standards and suggest appropriate remedial action. Unfortunately, only broad national clinical standards are available. However, some specific standards against which transport services can be audited have been used locally. Non-clinical aspects of neonatal transport medicine can be audited against directives from the Health and Safety Executive and medical electrical equipment standards. Audit and review with regard to avoidable adverse events is vital to the ongoing improvement and development of transport services for preterm infants.

Conclusion

Some newborn infants will always need to be moved between hospitals. Neonatal transport services must be well organised and should aim to provide clinical care to a high standard. The service should be staffed by professionals trained in neonatal transport medicine and in using appropriate equipment.

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Equipment bags and their contents vary according to the type of neonatal transport that they are used for



Loading mechanism for loading transport incubators into ambulances. All transport systems must meet regulation standards



Neonatal transport unit must be secured safely in the ambulance

Further reading

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